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FORESTS AND THEIR RETENTION OF RAIN WATER.

Fifty years ago a forester named Surell, published a study of torrents in the High Alps (*Etudes sur les torrents des Hautes-Alpes* 1870), a book that ran to a second edition two years later under the editorship of another,—E. Cézanne. In this work the re-afforestation of bared slopes was advocated as a remedy against landslips and denudation resulting from streams in flood. The book led the way for reports, such as Demontzey's "Removal of torrents in France by re-afforestation" (*L'extinction des torrents en France par le reboisement*, 1894). Yet, though by the end of the last century the principle had been recognised that forests prevent this kind of destruction, many, some resenting forest regulations, failed to realise their true importance: and therefore in 1900 a demonstration of the influence of forests upon the running off of the rainfall was commenced in Switzerland by that country's Central institute for the study of Forestry. For the demonstration two comparable valleys near Berne were selected: one with forest throughout, the other two-thirds in pasture. Rain guages were installed; and guages put upon the streams that carry the water away. As no arrangements could be made for keeping records at temperatures below freezing point, winter-observations were impossible: but after 18 years of observation in each year from April 16th to November 30th, the results have been published by Dr. Arnold Engler under the title of *Untersuchungen ueber den Einfluss des Waldes auf den Stand der Gewasser*.

The fate of the rain which fell, it is concluded, was:—

	from the forest	from the open
to be run off through the streams ..	60 parts	60 parts
to be evaporated from off the surface of the vegetation	5 ..	10 ..
to be evaporated from off the surface of the soil	15 ..	24 ..
to be taken up by the roots of the vegetation and thence passed back to the air by transpiration	20 ..	6 ..
	100 parts	100 parts

Now the last process takes time and it is obvious that the water so used must be delayed in its circuit: but the chief interest is the rate at which the 60 per cent was run off in the streams. It was run off rapidly from the pasture but slowly from the forest: thus in the springs when the thaw came, the forest allowed the liberated water to escape much more slowly than the pasture: and through the summers when sudden downpours occurred, the stream from the pasture valley for a time would discharge per second twice to thrice as much water as the stream from the forested valley, for the same fall of rain. In times of protracted rain the discharge per second would be something up to twice as much, the difference growing less, the longer the downpour extended; this is as one would expect for every soil has a limit of saturation, beyond which it can retain no more.

It follows from the way in which the first valley parted slowly with the rain that its forest soil must be much more uniformly moist than the pasture soil: but the reason for this is not, as most think, because the forest covering prevents the sun from reaching the soil: but is in the circumstance that a forest soil is absolutely different from one more exposed: it possesses properties for instance which it keeps for a time after the forest is removed, which we refer to when we call it a "virgin soil:" and the most useful of all the properties of virgin soil from a forest is that of holding moisture against the dessicating effects of exposure to the sun.

Several factors assist in bringing this about.

There is more humus in a forest soil than in a pasture soil; and the decay of the humus opens it: there are more roots in a forest soil than in a pasture soil; and they open it: and almost certainly there is an entirely different soil fauna, which brings about enormous differences. Possibly other differences could be enumerated; but the result of all is that forest soil has a porosity lacking in exposed soils, cultivate them as we will.

That the differences observed in the running off of the rainfall from his afforested valley and from his deforested pasture valley are due to the nature of the soil Dr. Engler appears to have no doubt.

The water of the stream from the pasture valley carried more sediment than that from the afforested valley.

Had the Swiss Institute's experiments been a comparison of an afforested valley with a bared valley, how much greater would the contrasts have been; and how much more forcefully would the second stream have poured down in flood, carrying the soil with it.

These Swiss observations have considerable interest in Malaya.

The porosity of a forest soil is well illustrated in the Peninsula by the way in which the peat-lands of Kukob and other low-lying places shrink if exposed for the cultivation of rubber. The steady release of the rainfall by hill forest is pleasantly shown in the early rice crops that the narrow upper ends of the valleys give in Malacca. The consequence of the removal of forest has been obvious enough in the same neighbourhood where the Railway has had to alter its

culverts that were silted up. Perhaps there are no records which would show that the Malacca river is less constant than formerly, but it is more than probable that it is less constant as a consequence of the extensive clearing of the rolling ground about the Malacca-Negri Sembilan boundary.

Virgin forest soils are, in Malaya, most interesting. They can be destroyed in a few years; but it would seem that they can only be build up by several tens of years; perhaps it takes one hundred to restore them. At any rate the real forest trees appear to demand one hundred years§ of preparation before they are again at home. Belukar in all its stages is the evidence of soil unfit for them. What they need and the soil has not got when carrying belukar is probably porosity plus the right soil fauna; and of soil fauna here we are extremely ignorant.

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SOME TESTS OF GARDEN VEGETABLES IN SINGAPORE—LETTUCES.

If reference be made to this Bulletin Vol. 2, No. 1, 1918, p. 9, a note will be found by Prof. C. F. Baker upon lettuces tried by him in the Economic Garden, Singapore. Since then, other lettuces have been tried, and the last of the experiments done, will be reported on here.

The seed came from three different firms, Messrs. Sutton and Sons, Reading, England; Messrs. Vilmorin, Paris; and Messrs. Dreer & Co. Philadelphia U. S. A. The lettuces of different origin could not be tried against each other, as it was impossible to sow them together, but those from each firm were grown side by side.

The method of cultivation was as follows:—

Soil and site. The soil selected for growing these was of two sorts (1) sandy loam; and (2) rich damp loam obtained from peat by constant cultivation, good drainage, and incorporation of lime. The soil was dug over twice, manured with cow manure at the same time, and then left exposed to the sun. After a week or so, beds 3 ft. broad and long according to the site, were made, and kept ready to receive the seedlings.

As for the sites, they were two: the first was above the zone of floods which have become somewhat frequent in the Economic Garden in the early part of the year; while the second was liable to flood. The first situation answered well while the weather was wet and in the dry spells with precautions, in giving water, keeping a fine dust mulch and giving shade in the middle of the day.

Germination and growth. Soon after the seeds were received they were sown in boxes in a soil with an addition of sand to run off extra water and to prevent damping off. The seeds usually

§ Cf. in the Gardens' Bulletin II No. 5, pp. 145—157, an account of Secondary jungle thirty years old,